ROCKY FLATS PLANT
GOLDEN, COLORADO

TECHNICAL REVIEW
DRAFT TREATABILITY STUDIES PLAN

Prepared for

U S ENVIRONMENTAL PROTECTION AGENCY
Region 8 Federal Facilities Remedial Branch
Denver, Colorado

Work Assignment No	C08061
EPA Region	8
Site No	CO789001526
Date Prepared	October 15, 1990
Contract No	68-W9-0009
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1 0 INTRODUCTION

PRC Environmental Management, Inc (PRC) reviewed the draft treatability studies plan for the environmental restoration program at the Rocky Flats Plant, Golden, Colorado PRC prepared this report for the U S Environmental Protection Agency (EPA) under Technical Enforcement Support (TES) 12, contract number 68-W9-0009, work assignment number C08061

This review is divided into two sections general comments (Section 2 0) concerning the entire document and specific comments (Section 3 0) relating to individual sections The review is based on the assumption that the treatability studies plan should address the elements required in Article XI (treatability study) of Attachment 2 (Federal Facility Agreement Statement of Work) of the interagency agreement (IAG) being developed among the U S Department of Energy, the State of Colorado Department of Health, and EPA

Several guidance documents were used in this review Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA/540/G-89/004), Guide for Conducting Treatability Studies Under CERCLA (EPA/540/2-89/058), Technology Screening Guide for CERCLA Soils and Sludges (EPA/540/2-88/044), and Technological Approaches to the Cleanup of Radiologically Contaminated Superfund Sites (EPA/540/2-88/002) Additional references include Ground Water Treatment Technology, by Evan K Nyer (1985), and Standard Handbook of Hazardous Waste Treatment and Disposal, by Harry M Freeman (1989)

2 0 GENERAL COMMENTS

1 The content of the draft treatability studies plan (TSP) does not entirely fulfill the scope of work presented in Article XI, Attachment 2, of the IAG The TSP does not include information on relative costs, removal efficiencies, operation and maintenance requirements, or implementability of all candidate technologies Similarly, the TSP does not discuss analytical methods, data management and analysis, health and safety, and residual waste management issues as specified in Article XI The TSP should address these issues for the screening and selection of candidate technologies for remedial alternatives and design

2 The TSP differentiates between practical technologies and emerging/innovative technologies However, the current document only discusses practical (demonstrated, conventional) technologies Site-wide treatability studies should include all technologies potentially applicable to mitigation of contamination at the site Identification and evaluation of emerging/innovative treatment technologies should be discussed in the TSP This should

include provisions to evaluate potentially applicable technologies identified after the TSP is finalized

3 Applicable or relevant and appropriate requirements (ARARs) should be identified during the screening of potential technologies before treatability testing Chemical-, action-, and location-specific ARARs may restrict the implementability of a particular technology at a site or indicate how a selected alternative must be implemented As part of the TSP, these ARARs will affect the selection of candidate technologies for treatability studies, remedial alternatives development, design, and action

4 Cleanup goals for target chemicals or waste groups should be defined in the TSP The basis for evaluating the effectiveness of a treatment technology is to calculate removal efficiencies and compliance with established cleanup criteria (based on ARARs, see comment 3) Similarly, data quality objectives (DQOs) should be established in the TSP to define the data quality needs of the treatability studies program

3 0 SPECIFIC COMMENTS

1 Page 3-1, Paragraph 2. The text states that protocols for conducting treatability tests are required to ensure the data collected are accurate, complete, and appropriate A usual objective in data collection is to obtain measurements and samples that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness. The text should include these standards in the protocols for conducting treatability studies Also, the data quality objectives for site-wide treatability studies should be defined

Rationale The implementation of an appropriate quality assurance/quality control (QA/QC) program is required to ensure data of known and documented quality are generated The quality of treatability testing data required should correspond proportionately to the implications of the decisions that will be based on those data

2 Page 4-5, Section 4.1. While summarizing the general contaminants of concern at the site, the text should indicate significant levels of acetone and toluene have been detected Acetone has been detected at various locations throughout the site, and at high (200-300 micrograms/kilogram (µg/kg)) concentrations at operable unit (OU) 2 in the vicinity of the mound areas Similarly, toluene has been detected at concentrations as high as 860 µg/kg at

OU 1 These contaminants should be considered in the selection of technologies for treatability studies

Rationale Acetone contamination is difficult to mitigate because it is extremely soluble in water High concentrations of acetone in waste streams or treatment residuals could affect the selection of a particular technology for remedial action Toluene can be mitigated with standard technologies for treatment of volatile organic compounds, but should be considered in the technology screening process

3 Page 5-1, Section 5.0. The technology screening and selection process should evaluate performance, implementability, removal efficiencies, relative costs, and operation and maintenance requirements of candidate technologies (Article XI, Attachment 2, IAG) Similarly, ARARs should also be identified, including land disposal restrictions (LDRs), Clean Air Act, fugitive dust and emission standards, transportation regulations, and design and operating standards

Rationale The treatment technologies should be carefully screened and selected after evaluating all relevant criteria ARARs, in particular, are threshold criteria for eliminating technologies early in the screening process All ARARs should be identified before beginning treatability and feasibility studies (Also see general comments 1 and 4)

4 Page 5-3, Paragraph 1. The text lists three criteria for eliminating practical technologies from treatability tests However, well-proven technologies should not necessarily be eliminated from laboratory or bench-scale testing during the screening process

Rationale Laboratory and bench-scale tests are frequently used to evaluate specific waste types and waste streams with proven technologies For example, biological treatment is well proven, but treatability tests are necessary to determine the waste stream toxicity and the removal efficiency of the treatment system for the specific waste

5 Page 5-4, Paragraph 3. The primary objective of the treatability program as stated is to demonstrate the effectiveness of a given technology in reducing contaminant concentrations Technologies may then be screened to develop remedial alternatives The data from the treatability studies also should demonstrate the implementability and cost of a given technology

Rationale   Effectiveness, implementability, and cost are the three criteria for technology screening and development of remedial alternatives If the results from treatability studies are to provide necessary information for planning OU-specific programs, these criteria should be evaluated (Also see general comment 1)

6   Page 5-7, Section 5.1.2. Chemical-specific ARARs should be identified and evaluated more carefully and included in the text Similarly, location- or action-specific ARARs should not be deferred to full-scale implementation of the remedial alternative

Rationale   Chemical-specific ARARs establish the acceptable level or concentration of a chemical that may be found in, or discharged to, the ambient environment For example, the national ambient air quality standards (NAAQS) under the federal and state clean air act are chemical-specific ARARs Action-specific ARARs may affect the implementability of a particular technology at the site Action-specific requirements do not in themselves determine the remedial alternative, rather they indicate how a selected alternative must be implemented Location-specific ARARs may restrict the conduct of remedial activities or the concentration of hazardous substances solely because they are occurring in a particular place

7   Page 5-7, Paragraph 1. The toxicity characteristic leaching procedure (TCLP) is included in the text as a potential ARAR The TCLP is the method to identify Resource Conservation and Recovery Act (RCRA)-characteristic or -listed wastes The TCLP itself is not a regulatory level or potential ARAR This should be corrected in the text

Rationale   Correct usage of terms minimizes the potential for misinterpretation

8   Page 5-15, Section 5.2 1. For practical purposes, the contaminants at the site were divided into five major groups The text should also identify indicator or target chemicals of concern within each contaminant grouping that will be used to screen technologies Indicator chemicals are selected based on concentrations and common contaminant fate and transport characteristics

Rationale   Contaminant groupings are practical for preliminary identification of technologies However, selection of technologies should also be based on effectiveness of treatment of indicator chemicals at the site Treatability processes can be screened for a group of contaminants (for example, volatile organic compounds (VOCs)) However, individual chemicals will behave differently within that group For example, toluene and pxylene are relatively biodegradable, but o-xylene, m xylene, and ethylbenzene are relatively undegradable Similarly, trichloroethene is readily adsorbed on granular activated carbon, but vinyl chloride is only adsorbed in trace amounts

9 Page 5-17, Section 5.2.2. This section identifies practical technologies and applications for treatment of the five categories of contaminants However, the identification of practical technologies for treatment of contaminants in soil and ground water is limited The text should be expanded to include additional technologies and variations of listed technologies Similarly, technologies for treatment of output streams and side streams generated as a result of treatment processes (for example, off-gas or aqueous effluent polishing from an air stripper) should be considered and listed in the text Finally, technologies for treatment of light or dense nonaqueous phase liquids should be considered

Rationale There are additional practical technologies which have not been considered in the TSP Practical technologies for water and soils that should also be considered are listed below These technologies have all been demonstrated at full scale

WASTE GROUP	WATER	SOILS
Inorganic contaminants	Thermal treatment - wet air oxidation - pyrolysis Carbon adsorption Neutralization	Thermal treatment In-situ chemical treatment Vitrification (in-situ or ex-situ) Solidification/stabilization
Radionuclides	Chemical extraction	Cement-based stabilization In-situ vitrification
Metals	Precipitation/flocculation/ sedimentation Oxidation/reduction	Cement-based stabilization In-situ vitrification Soil flushing
Volatile and semi-volatile organic compounds	Ultraviolet photolysis Incineration - liquid injection - rotary kiln - fluidized bed - pyrolysis Liquid-liquid extraction Microbial degradation (in situ) Glycolate dechlorination	Steam stripping In-situ vitrification Chemical extraction Glycolate dechlorination Pyrolysis

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10 Page 5-27, Paragraph 3. The text states effectiveness refers to the ability of a technology to treat a given volume of waste based on cleanup goals However, cleanup goals have not been set Cleanup goals for contaminants or waste groups at the site should be defined in the treatability studies plan

Rationale Evaluating effectiveness without knowing cleanup goals or desired removal efficiencies is not appropriate (Also see general comment 3)

11 Page 5-28, Section 5.2.3. The rationale for selection or elimination of practical technologies for stage I treatability studies is not clear With few exceptions, most treatment processes require treatability testing to determine the effectiveness for site-specific compounds, mixtures, and hydrogeologic conditions Many conventional, demonstrated technologies require treatability studies to reduce cost and performance uncertainties for treatment alternatives to acceptable levels to support the selection of the alternative and remedial design For an area-wide technology evaluation, each candidate technology should be evaluated with respect to data needs and treatment goals for the site Criteria should be defined for selecting practical technologies for treatability studies with respect to effectiveness, implementability, and cost for mitigation of specific contaminants at the site

Rationale It is difficult to identify treatment technologies applicable to all contaminant groups or even all individual contaminants within a group Treatability testing should generate information for site-wide target compounds The best technology for specific contaminants and contaminant groups should be evaluated and combinations of the technologies can then be selected for effective remediation of contaminants throughout the site and each OU

12 Page 5-30, Paragraph 4. Granular activated carbon (GAC) adsorption should be considered for stage I treatability tests GAC technology requires treatability tests to evaluate applicability to organic contamination at the site For mixtures of contaminants known to exist at the site, liquid-phase adsorption isotherm tests should be performed Subsequent dynamic column studies (batch tests) can be used to determine optimum contact time, mass transfer zones, and system configuration

Rationale Treatability studies are necessary to evaluate the effectiveness, implementability, and cost of GAC technology for conditions at Rocky Flats

13 Page 5-31, Paragraph 2. Membrane processes such as reverse osmosis and electrodialysis should be considered for stage I treatability tests Although these are demonstrated technologies for certain metals, they should be evaluated for specific conditions at Rocky Flats For example, for an efficient reverse osmosis process, the chemical and physical properties of the semipermeable membrane must be compatible with waste stream characteristics Simple (bench scale) treatability studies could evaluate the optimum membrane requirements (geometry, chemistry, pore size) for effective removal of contaminants at Rocky Flats Finally, the text should indicate what water quality parameters (concentration limits) are required for testing of these processes

Rationale Treatability tests are necessary to evaluate reverse osmosis and electrodialysis technologies for conditions at Rocky Flats

14 Page 5-31, Paragraph 5. In-situ and above ground biological treatment are conventional and commercially available technologies and should not be deferred to the innovative/emerging technology assessment These treatment processes, although sufficiently demonstrated, still require treatability tests to predict biological toxicity in the treatment plant

Rationale Biological treatment processes are well demonstrated and not innovative or emerging These treatment processes almost always require treatability tests to evaluate effectiveness and implementability for site-specific conditions

15 Page 6-1, Paragraph 3. The text states DQOs levels II and III will be used for all treatability studies However, DQOs for the treatability tests will vary depending on the significance and magnitude of the study The text should be corrected to indicate the DQOs will be established for individual treatability studies

Rationale In general, analytical levels I and II apply to laboratory screening treatability studies, and analytical levels III, IV, and V apply to bench- and pilot-scale treatability studies

16 Page 6-1, Paragraph 4. The text implies that the median and average contaminant concentrations for waste distributions will be the same However, this is not necessarily true, and in general, the median and average values will be different The text should state whether treatability tests will be performed with waste containing either the median or the average concentrations

Rationale Unless the concentrations are normally distributed, which is seldom the case with chemical analyte populations, the median will not equal the average (mean) It is important to differentiate between median and mean for treatability testing as they may be significantly different depending on the distribution of values

17 Page 6-2, Paragraph 1. The text indicates that multivariable analyses will be provided, where appropriate, on additional tests to supplement treatability studies The text should indicate the types of multivariable analyses to be performed during additional tests

Rationale The utility of providing multivariable analyses (where appropriate) is not clear without the identification of specific tests

18 Page 6-5, Paragraph 2. While discussing the test approach for oxidation/reduction (redox) treatability studies, the text should specify the need for sampling waste stream and side stream residuals for evaluation during screening and selection The text should indicate the need to identify/characterize the disadvantages and limitations of a particular process in addition to its effectiveness

Rationale Chemical redox is an indiscriminant process and can result in incomplete reactions or unwanted side reactions When using chemical redox techniques with chlorinated organic compounds the possibility of producing hydrochloric acid exists Leach tests will need to be conducted on residual solids to determine the need for stabilization, and the liquid effluent should be analyzed to determine the need for further treatment

19 Page 6-8 Paragraph 2. The TSP considers soil washing for organic compounds an innovative/emerging technology However, soil washing for organic compounds is a demonstrated, practical technology and should be part of the TSP

Rationale Soil washing for organic compounds has been effectively demonstrated using alkaline agents, surfactants, and biodegradable polysaccharides

20 Page 6-12, Paragraph 1. The test objectives of the solidification/stabilization treatability tests should include determination of waste-to-additive ratios, mixing, and curing conditions The short-term environmental impact of stabilizing wastes may be small, but long-term reliability is not well known Provisions for monitoring all applicable parameters for the technology screening process should also be included in the objectives

Rationale Leachate produced as a result of the curing process should be collected and analyzed The heat generated by the curing or stabilization can drive off volatile organic compounds and may necessitate gas monitoring or screening The determination of optimum waste-to-additive ratios, mixing, and curing conditions should be primary considerations during the treatability study

21 Page 6-16, Paragraph 2. Phase 2 of the biological treatment treatability study should also establish optimum slurry densities, pH, temperature, and residence time The need to monitor these parameters should be included in the statement of work

Rationale The treatability study should monitor all parameters which are used to evaluate a technology in terms of implementability, cost, and effectiveness for technology selection and design

22 Page 7-1, Section 7.0. This section discusses schedules and deliverables for the treatability studies program, but only includes practical technologies Schedules and deliverables for emerging/innovative treatment technologies treatability studies and treatability study work plans should be included

Rationale The evaluation of emerging/innovative technologies is an integral component of the treatability studies for Rocky Flats, but is not included in this document Based on existing information, the treatability study plan should provide a statement of work for evaluating candidate technologies This includes innovative/emerging technologies Examples of these technologies from the Superfund Innovative Technology Evaluation (SITE) program are membrane microfiltration, solvent extraction, plasma reactor, infrared thermal destruction, and freezing separation (Also see general comment 2)